A SUMMARY OF CIAT's FINDINGS AND RESEARCH APPROACH TO IMPROVE BEAN PROTEIN DIGESTIBILITY

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The relatively low bean protein digestibility, 70% in average, implies high energetic and nutritional losses, especially in regions where beans are a staple food, as Latin América and some areas in Africa.

In 1987 CIAT expanded its research effort to understand and solve some quality and nutritional problems, and protein digestibility was considered as priority. During 1987-1989 a detailed "in vitro" digestibility study was carried out to identify the factors that control bean protein digestibility using 8 genotypes representing a range of testa colors. This study showed that the factors can be separated into three groups: testa factors (tannins and fiber); cotyledonary factors (protease inhibitors, part of the dietary fiber, and protein structure) and soluble factors (some proteinaceous and non-proteinaceous compounds that were soluble in broth). The later were quantified but were very small. The testa factors do not explain more than 25% of the reduction in protein digestibility and cotyledonary factors explain about 75%. Of these the protease inhibitors do not play a significant role in cooked grain, the cotyledonary dietary fiber account for about 20% (according to experience of INCAP, Guatemala) and more than 50% of the problem can be explained as a problem of protein structure itself. Further studies of the relationship between digestibility and the types of phaseolin, lectins and arcelin were carried out in 1989-1990. These studies suggested that phaseolin was the principal fraction responsible for reduced digestibility. A relationship between non utilized protein and phaseolin type was demostrated, and also between the phaseolin amount and digestibility. These results led us to focus on phaseolin as a main research area to improve bean protein digestibility. The 36 known phaseolin types were purified and characterized by two-dimensional gel electrophoresis and densitometry, obtaining information on MW, pI and relative amount of each type of polypeptide chain. Susceptibility to cleavage has been studied with phaseolins S and T through peptide mapping. This work will be extended using other phaseolins and about 20 specific enzymes and inorganic chemical compounds, to try to determine which polypeptides of phaseolin present superior digestibility. We are interested in the possibilty of genetically substituting protein fractions of higher digestibility, including a phaseolin variant, if some proves to be more digestible. We are presently completing an "in vivo" trial with rats, carried out in collaboration with the Universidad Industrial de Santander in Colombia, comparing digestibility of beans with different phaseolin types, and we hope to complement this with a similar trial using purified phaseolins.

Simultaneously, studies of lines with phs- and lec- genes have permitted insights into patterns of compensation among seed protein fractions. For example, normally about 10% of bean seed protein exists as lectins; with the lec- gene, compensation results in at least an 8% increase in Phs.

Our long term goal is to increase protein digestibility by 15-20%, that is, to 85-90%.Suggestions or collaboration with BIC colleagues are welcome.